PATENT ABSTRACTS OF JAPAN

(11)Publication number : 11-130876

(43)Date of publication of application : 18.05.1999

(51)Int.Cl. C08J 5/16
C08K 7/02
C08L101/00
F16C 33/24

(21)Application number : 09-297572

(22)Date of filing : 29.10.1997

(71)Applicant : KYOCERA CORP

(72)Inventor : TANDA HIROKO
ISHIMINE YUUSAKU
ENOKIDA KOJI

(54) SLIDING MEMBER

(57)Abstract:

PROBLEM TO BE SOLVED: To obtain a sliding member comprising a resin composite having excellent abrasion resistance and heat resistance in sliding under high-speed and high load and having small sliding torque even in long-period use.

SOLUTION: This sliding member is formed by constituting one main face of a resin composite composed of 30-70 vol.% fibrous filler made of carbon fiber or organic fiber and 70-30 vol.% thermosetting resin as a sliding face and uniformly arranging pores on the sliding face and putting a lubricating oil or a resin-based solid lubricating agent into pores.

LEGAL STATUS

[Date of request for examination] 22.08.2001

[Date of sending the examiner's decision of rejection] 12.08.2003

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] The slide member which comes to sink into the pore which becomes considering one principal plane of the resin complex which consists of 30 - 70 capacity % and thermosetting resin of 70 - 30 capacity % the fibrous filler which consists of a carbon fiber or organic fiber as a sliding surface, and exists in homogeneity mostly at this sliding surface in the solid lubricant of a lubricating oil or a resin system.
[Claim 2] The slide member according to claim 1 the rate of occupancy area of whose the pitch diameter of the pore in the above-mentioned sliding surface is 15-80 micrometers, and is 3 - 30%.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] About the slide member which consists of resin complex of thermosetting resin and a fibrous filler, this invention has abrasion resistance and thermal resistance also in sliding under a high speed and a heavy load load, and has the sliding property in which coefficient of friction was small excellent, and, specifically, is suitable for the tape guide to which it shows tape-like objects, such as a separation pawl of image formation equipments, such as a pulley, a washer, bearing or a printer, and facsimile, and a magnetic tape.
[0002]
[Description of the Prior Art] Although many metals were conventionally used as slide members, such as a pulley, and a washer or bearing, the substitution to resin is considered by the demand of lightweight-izing, productivity, etc. Reinforcement, dimensional stability, chemical resistance, etc. are required of the resin used for such a slide member other than thermal resistance in many cases, thermosetting resin was used for it from the point of the configuration stability at the time of abnormality generation of heat, also especially in it, it excelled in the moldability and phenol system resin available comparatively cheaply was used abundantly.
[0003] Moreover, the slide member which consists of resin complex which raised reinforcement, thermal resistance, and abrasion resistance is also proposed rather than the resin simple substance by blending a fibrous filler with resin, for example, there was a thing using an asbestos fiber, ceramic fiber, a metal fiber, organic fiber, etc. as a fibrous filler (refer to JP,2-40130,B).
[0004] In addition, generally the slide member which makes these resin a subject was manufactured by the injection-molding method for pouring in and carrying out heat hardening of the resin slurry into the metal mold of a predetermined configuration.
[0005] Moreover, the slide member which consists of ceramics, such as an alumina, was also used for the slide member as which the use under a high speed and a heavy load load is required with thermal resistance.
[0006]
[Problem(s) to be Solved by the Invention] By the way, in the slide member used under a high speed and a heavy load load, although making it slide in the condition of having applied lubricant to the sliding surface and having made lubricant intervening between sliding surfaces with phase hand part material was performed, the sliding surface of the slide member which consists of resin complex which blended the resin simple substance conventionally manufactured by the injection-molding method and the fibrous filler was a smooth side.
[0007] Thermosetting resin is as this reason for hardening to be started by the chemical reaction with a curing agent. For example, when thermosetting resin is phenol novolak resin, a hexamethylenetetramine is used as a curing agent. Although a polymerization hardening reaction is produced by the reaction which a hexamethylenetetramine decomposes with heating, an aldehyde is generated, and this aldehyde attacks the hydroxyl group of a phenol, and results in bridge formation The gas other than an aldehyde,

such as a carbon dioxide, ammonia, and a steam, occurs at the time of decomposition of the above-mentioned hexamethylenetetramine. And within and without the resin complex which a pressure will not be transmitted if these gas occurs in injection molding, but processing of gas drainage etc. is usually performed from fabricating becoming poor, consequently constitutes a slide member, pore was hardly found, but the sliding surface was finished flat and smooth.

[0008] However, while lubricant tended to flow out that a sliding surface is a smooth side and sliding torque became large rapidly for a short period of time, since the heat-conduction property of thermosetting resin was not so good, when lubricant was lost, the technical problem that it wore out greatly with the frictional heat accompanying sliding with phase hand part material occurred.

[0009] For example, as a result of the resinous principle which exists in a sliding surface that phase hand part material is metals, such as stainless steel, softening with frictional heat and producing adhesion with phase hand part material, the sliding surface was greatly worn out, and the resinous principle to which phase hand part material exists in a sliding surface that an alumina etc. is the ceramics of a heat-conduction property which is not so good was carbonized by frictional heat, and this carbonization layer was greatly deleted by phase hand part material, and was worn out by it.

[0010] And in the slide member which consists of resin complex, there was also fear of deleting phase hand part material as a fibrous filler is hard ceramic fiber metallurgy group fiber, and making it wear out greatly.

[0011] Moreover, a slide member which consists of resin complex use was regulated by problems, such as work environment, and the slide member which consists of resin complex which blended the asbestos fiber excelled [complex] in an asbestos free-lancer's thermal resistance while carcinogenic [asbestine] attracted attention and the regulation system became still severer in recent years was desired.

[0012] Furthermore, when the filler was blended so much by the injection-molding method, while the flow nature of resin fell and the moldability worsened, since wear of metal mold was caused, it was difficult to raise the loadings of a fibrous filler, consequently it could not raise the reinforcement or thermal resistance of resin complex, and since the running cost of equipment was high, the technical problem that it could not manufacture cheaply also occurred.

[0013] On the other hand, the slide member made from the ceramics had the large specific gravity of the ceramics compared with resin, from a manufacturing cost being high, it was cheap and there was a technical problem that it could not be used in the slide member as which lightweight-ization is required.

[0014]

[Means for Solving the Problem] While this artificer etc. makes the sliding surface of the slide member which consists of resin complex which blended the fibrous filler which becomes thermosetting resin from a carbon fiber or organic fiber distribute pore to homogeneity that the above-mentioned technical problem should be solved as a result of examining many things While reducing a touch area with phase hand part material and reducing frictional resistance by infiltrating the solid lubricant of a lubricating oil or a resin system into the above-mentioned pore By the solid lubricant of the lubricating oil which sank into pore, or a resin system, oneself and others find out that the slide member in which wear has the outstanding small sliding property of coefficient of friction few is obtained also in sliding under a high speed and a heavy load load.

[0015] That is, the slide member of this invention is characterized by infiltrating the solid lubricant of a lubricating oil or a resin system into the above-mentioned pore while it becomes considering one principal plane of the resin complex which consists of 30 - 70 capacity % and thermosetting resin of 70 - 30 capacity % the fibrous filler which consists of a carbon fiber or organic fiber as a sliding surface and makes pore this sliding surface exist in homogeneity mostly.

[0016] Moreover, this invention makes the rate of occupancy area of pore 3 - 30% while setting the pitch diameter of the pore in the above-mentioned sliding surface to 15-80 micrometers.

[0017]

[Embodiment of the Invention] Hereafter, the operation gestalt of this invention is explained.

[0018] The slide member of this invention has made the loadings of a fibrous filler 30 to 70 capacity % while it consists of thermosetting resin and resin complex of a fibrous filler and makes the loadings of

the above-mentioned thermosetting resin 70 to 30 capacity %.
[0019] Having made the loadings of 70 to 30 capacity % and a fibrous filler into 30 to 70 capacity % the loadings of thermosetting resin here While the deformation at the time of many (the loadings of a fibrous filler under 30 capacity %) and heat hardening has the loadings of resin larger than 70 capacity % and high firmness (dimensional accuracy) is no longer acquired It is because load deflection temperature becomes low, so the firmness after the powder pressing which is because thermal resistance falls and the loadings of resin mention later conversely under by 30 capacity % (more mostly [fibrous filler / loadings] than 70 capacity %) is not acquired.
[0020] As thermosetting resin which constitutes such resin complex, resin, such as an epoxy system, a phenol system, and a melamine system, can be used, and phenol system resin is suitable from viewpoints, such as thermal resistance, dimensional stability, and chemical resistance, also in these.
[0021] On the other hand, as a fibrous filler, a carbon fiber or organic fiber can be used, and if it adds with the loadings which mentioned these above, while being able to raise the reinforcement of a slide member, thermal resistance, dimensional stability, and abrasion resistance, phase hand part material is not damaged. Since especially a carbon fiber has self-lubricating properties, it can raise a sliding property more. In addition, as the above-mentioned organic fiber, aromatic series PA, an aramid fiber, cellulose fiber, etc. can be used.
[0022] Moreover, maximum Itonaga of a fibrous filler is good to be referred to as 200 micrometers or less. It is because the dispersibility at the time of mixing with resin is bad, so the **** part of a fibrous filler and a dense part will be made in the interior and the surface section of resin complex, and the reinforcement by having blended the fibrous filler, thermal resistance, and abrasion resistance cannot be raised and it will be easy to generate a chip at the time of the mold release after the powder pressing at the time of manufacture, if maximum Itonaga of a fibrous filler becomes longer than 200 micrometers. However, if maximum Itonaga becomes shorter than 5 micrometers, since the reinforcement effectiveness by having blended the fibrous filler will no longer be acquired, 5-200 micrometers of things set to 5-150 micrometers of maximum Itonaga of a fibrous filler are preferably good.
[0023] In addition, the fibrous filler shown as a white pillar-shaped object exists in the random direction in resin complex so that he may show the photograph which expanded a part of drawing 1 to drawing 2 further approximately, although Itonaga of a fibrous filler is the die length of the longest part when the dimension of right and left and the upper and lower sides is measured. When measuring maximum Itonaga of a fibrous filler from a slide member by this invention for the reason, the die length of the longest fibrous filler in the fibrous filler which expanded five places of the front face of the arbitration of a slide member or a cross section with the metaloscope or the electron microscope (SEM), and analyzed them with image-analysis equipment for convenience is made into maximum Itonaga.
[0024] Moreover, let area in which the capacity factor of resin and a fibrous filler part occupy the area which expands the front face or cross section of arbitration of a slide member with a metaloscope or an electron microscope (SEM), and distinguishes a resin part and a fibrous filler part with image-analysis equipment as a means to measure loadings, and a resin part occupies in the measured whole surface product be the capacity factor of a fibrous filler. Furthermore, if clay, talc, a mica, a kaolin, silica sand, a calcium carbonate, an alumina, a silica, graphite, etc. are added to the resin complex which constitutes the slide member of this invention as reinforcing materials, while being able to raise the reinforcement of resin complex further, it is also possible to add a coloring agent if needed.
[0025] Moreover, the slide member of this invention has sunk the solid lubricant of a lubricating oil or a resin system into this pore while the pore shown in the sliding surface black exists in homogeneity mostly so that the photograph which expanded the sliding surface to drawing 1 may be shown.
[0026] Thus, since the above-mentioned pore is made into oil ****** and the solid lubricant of a lubricating oil or a resin system is sunk in and held while being able to reduce a touch area with phase hand part material and being able to reduce a sliding friction by making pore a sliding surface exist in homogeneity mostly, at the time of sliding, the viscosity of the lubricating oil in pore or the solid lubricant of a resin system can fall moderately with frictional heat, and only an initial complement can be supplied between sliding surfaces with phase hand part material. Also in sliding under a high speed

and a heavy load load, coefficient of friction can be very small, and it can be made to slide smoothly with low torque for the reason. Consequently, since the solid lubricant of a lubricating oil or a resin system is held in pore while the resinous principle of a sliding surface can carry out adhesive wear, or being able to prevent being carbonized and being able to reduce wear of a sliding surface sharply, it can consider as the slide member from which a smooth sliding property is acquired also in long-term use.

[0027] However, in order to satisfy such a property, while setting to 15-80 micrometers the pitch diameter of the pore made to exist in a sliding surface, it is good to make the rate of occupancy area of the pore in a sliding surface into 3 - 30%.

[0028] While producing faults, such as bulging, in the appearance after the heat hardening at the time of manufacture, and being unable to maintain desired dimensional accuracy, if it is difficult to infiltrate a lubricating oil and the lubricant of a resin system into pore as the pitch diameter of pore is less than 15 micrometers and it becomes conversely larger than 80 micrometers, and also the anti-chip box reinforcement of a slide member falling greatly, it is because the lubricating oil held in pore and the lubricant of a resin system become easy to flow out. Moreover, it is because it cannot be used as a slide member since anti-chip box reinforcement falls to 80 or less MPas if the effectiveness that it raises a sliding property at less than 3% though the rate of occupancy area of pore infiltrates a lubricating oil and the lubricant of a resin system into pore is small and becomes large from 30%.

[0029] In addition, it can ask by carrying out image analysis of the image to which the sliding surface was expanded with the metaloscope as an approach of measuring the pitch diameter and the rate of occupancy area of pore in the above-mentioned sliding surface.

[0030] As the above-mentioned lubricating oil, moreover, alpha olefin oligomer of a hydrocarbon system, Polybdenum, alkylbenzene, the polyphenyl ether of an ether system, A polyethylene glycol, a polypropylene glycol, ethylhexyl SEBAGETO of an ester system, The polysiloxane of an ethylhexyl horse mackerel bait and a silicone system, silicate ester, The fluorocarbon, the bar fluoropoly ether, or thoria reel phosphoric ester of a fluorine system, Trialkyl phosphoric ester, trimethylol propane ester, BENTA erythritol ester, The lubricating oil of petroleum systems, such as synthetic lubricating oils, such as a NEOBEN chill polyol ester, paraffin series, a naphthalene system, and an aromatic series system, vegetable oil, etc. can be used. As a solid lubricant of a resin system 4 ****-ized ethylene (PTFE), a polyamide (PA), polyacetal, high density polyethylene (HDPE), etc. can be used.

[0031] On the other hand, in order to manufacture the slide member of such this invention, while blending a fibrous filler with thermosetting resin, in order to stiffen the above-mentioned thermosetting resin at the time of heating, a curing agent is blended first. When thermosetting resin is phenol novolak resin as a curing agent, a hexamethylenetetramine can be used, a hexamethylenetetramine decomposes at the time of heating, an aldehyde is generated, and resin is stiffened by the reaction which this aldehyde attacks the hydroxyl group of a phenol and results in bridge formation.

[0032] Moreover, what is necessary is just to mix to homogeneity using a well-known approach, if in charge of combination. For example, a fibrous filler and a curing agent are mixed by the mixer to thermosetting resin, and there is the approach of pulverizing, after grinding after kneading by Brabender, or carrying out melting kneading of the thermosetting resin which blended the curing agent with the fibrous filler with a heating roller etc. Moreover, if needed, you may corn so that it may become a predetermined grain size.

[0033] However, as for combination of thermosetting resin and a fibrous filler, Itonaga blends a 50-200-micrometer fibrous filler in the range of 30 - 70 capacity % to the thermosetting resin of 70 - 30 capacity %. Thus, since restoration variation to the inside of metal mold can be lessened by making the bulk height of a fibrous filler small while being able to raise dispersibility with resin, maintaining a tangle of fibrous fillers required acquiring the reinforcement effectiveness because Itonaga uses a 50-200-micrometer fibrous filler, the dimensional stability of the resin complex after heat hardening, reinforcement, thermal resistance, and abrasion resistance can be raised.

[0034] In addition, as for the curing agent added in order to stiffen thermosetting resin, it is desirable to add at a rate of 8 - 14 capacity % to thermosetting resin. Moreover, reinforcing materials and a coloring agent which were mentioned above besides these may be blended, and well-known additives, such as a

hardening assistant, lubricant, a plasticizer, a dispersant, a coloring agent, and a release agent, may be added with extent which is not a problem practically if needed. Furthermore, since there is a possibility that the dispersibility at the time of mixing may worsen depending on the surface state and configuration of a fibrous filler, when such, dispersibility may be raised to the front face of a fibrous filler by covering a coupling agent.

[0035] Next, the raw material blended with homogeneity is filled up with each rate into metal mold, and it is 1 - 3 ton/cm2 at ordinary temperature. After carrying out powder pressing by the pressure, a Plastic solid is released from mold from metal mold, and heat hardening is carried out to the description of thermosetting resin, the loadings of a fibrous filler, the dimension of a product, etc. at the temperature of 80 in all-250 degrees C the appropriate back. Since pore is fill uped with the surface section with softening of a resinous principle while the gas generated with disassembly of a curing agent while being decomposed, the curing agent in a Plastic solid reacting with thermosetting resin and resin's hardening at this time falls out from the interior of resin complex and much pores are formed in the interior of resin complex, the resin complex with which pore existed in homogeneity mostly only inside is obtained.

[0036] And 15-80 micrometers and the rate of occupancy area are made into 3 - 30% for the pitch diameter of the pore which controls suitably the programming rate at the time of the above-mentioned heat hardening, the keeping time amount in a maximum temperature, a cooling rate, etc., and exists in the cutting plane of resin complex. In addition, it is because resin will be carbonized if making temperature at the time of heat hardening into 80-250 degrees C has inadequate hardening of resin in it being less than 80 degrees C and it becomes higher than 250 degrees C.

[0037] While processing the obtained resin complex into a predetermined configuration in this way, polish processing is performed to one principal plane of resin complex, and it deletes until the pore which exists in the interior of resin complex is exposed, and a sliding surface is formed.

[0038] And what is necessary is just to infiltrate a lubricating oil and the fixed lubricant of a resin system into the pore of a sliding surface by carrying out vacuum suction, after a slide member is immersed into the solid lubricant of the shape of a varnish diluted with an above-mentioned lubricating oil or an above-mentioned solvent although a lubricating oil and the fixed lubricant of a resin system are infiltrated into the pore of the above-mentioned sliding surface. In addition, what is necessary is just to make it sink in similarly in the condition of having made it heating and softening, when the viscosity of a lubricating oil or fixed lubricant is high.

[0039] Thus, the slide member of this invention consists of thermosetting resin and resin complex of a fibrous filler. While being able to blend the loadings of the difficult fibrous filler even with 70 capacity % by the conventional injection-molding method at a large quantity and being able to raise the thermal resistance of resin complex, and abrasion resistance from having manufactured by powder compression moulding technique The thermal resistance in which load deflection temperature was excellent with 200-300 degrees C since pore exists in homogeneity mostly at a sliding surface and a lubricating oil or the fixed lubricant of a resin system was infiltrated into this pore, In sliding under a high speed and a heavy load load, the cheap slide member which has the outstanding small sliding property of coefficient of friction can be obtained that oneself and others have little wear.

[0040] If the slide member of this invention is used for the reason, it can be suitably used as a slide member containing the tape guide to which it shows tape-like objects, such as a separation pawl of image formation equipments, such as a pulley, a washer, bearing or a printer, and facsimile, and a magnetic tape.

(Example 1) While preparing the slide member of this invention, and the conventional slide member and measuring each flexural strength and thermal resistance, it experimented with the pin-on disk testing machine about change of abrasion resistance and coefficient of friction in sliding time amount.

[0041] The slide member of this invention receives the phenol novolak resin of 35 capacity %. Itonaga a 100-micrometer carbon fiber 65 capacity %, 12 capacity % combination of a hexamethylenetetramine is done as a curing agent, and it is filled up with this compound into metal mold, and is 1 ton/cm2 at ordinary temperature. After carrying out powder pressing in press ** of extent, By carrying out heat hardening at the temperature of about 150 degrees C, the resin complex with which pore existed in the

interior was produced, and the disk which performed grinding and polish processing to these resin complex, and pore distributed to the sliding surface was manufactured. What infiltrated silicate ester as a lubricating oil into the pore of a sliding surface was used the appropriate back. In addition, 18 micrometers and the rate of occupancy area of the average pore diameter of the pore in a sliding surface were 5%.

[0042] Moreover, to the phenol novolak resin of 50 capacity %, Itonaga did 12 capacity % combination of a hexamethylenetetramine for the 100-micrometer carbon fiber as 50 capacity % and a curing agent, and the conventional slide member manufactured the resin complex which does not have pore in and abroad by injection molding in this compound, and manufactured the disk which performs grinding and polish processing to these resin complex, and does not have pore in a sliding surface. What applied silicate ester to the sliding surface as lubricant was used the appropriate back.

[0043] And while pressing the pin which consists of alumina ceramics of 99.5% of purity to each disk by the 1kg force, the disk was rotated at the rate of 5 m/sec for 100 hours, and it measured about change of coefficient of friction in the abrasion loss and sliding time amount of a disk and a pin.

[0044] Moreover, each sample is JIS. K About flexural strength, it is JIS by 6911. K Load deflection temperature was measured by 7207, respectively.

[0045] Each result is as being shown in Table 1 and drawing 3 .

[0046] Consequently, since this invention article made the compounding ratio of a carbon fiber high, although load deflection temperature was as high as 250 degrees C and had pore in the sliding surface, it was able to make flexural strength conventionally comparable as elegance.

[0047] Moreover, conventionally, since the sliding surface of elegance is a smooth side, there are many outflows of a lubricating oil and sliding torque increases by sliding it is [sliding] about 70 hours. As opposed to wear having been looked at by the both sides of a disk and a pin, and having worn especially the disk out greatly this invention article Since the lubricating oil was made to have held in the pore with which a sliding surface is equipped, also in sliding of 100 hours, it did not see, wear was not looked at by the pin, but increase of sliding torque was able to be suppressed to 0.5x103 mm3 / kg/km also in the disk.

[0048]

[Table 1]

		本発明	従 来
配合比	フェノールノボラック樹脂 (容量%)	35	50
	りょう 炭素繊維 (容量%)	65	50
気孔の平均径 (μm)		18	—
気孔の占有面積率 (μm)		5	—
荷重たわみ温度		250	170
曲げ強度 (MPa)		118	120
ディスク比摩耗量(10^3mm^3/kg/km)		0.5	156
ピン比摩耗量(10^3mm^3/kg/km)		0	5

※ ピン材はアルミナセラミックスである。

[0049] (Example 2) Next, in this invention article in an example 1, what changed phenol novolak resin, the loadings of a carbon fiber, the pitch diameter of the pore which exists in a sliding surface, and the rate of occupancy area was prepared, respectively, and it experimented about flexural strength, thermal resistance, abrasion resistance, and coefficient of friction, respectively.
[0050] In addition, the pin which consists of alumina ceramics of 99.5% of purity to each disk using a pin-on disk testing machine about abrasion resistance and coefficient of friction was pressed by the 1kg force, and while measuring coefficient of friction when rotating a disk at the rate of 5 m/sec for 100 hours, the abrasion loss of a disk and a pin was measured after that.
[0051] Each result is as being shown in Tables 2 and 3.
[0052] Consequently, in sample No.1, since each loadings of thermosetting resin and a fibrous filler were within the limits of 30 - 70 capacity %, although it had sufficient flexural strength and thermal resistance, since there were few rates of occupancy area of the pore which exists in a sliding surface as 2%, sufficient lubrication action to a lubricating oil was not obtained. Wear of a pin was also seen, while for the reason 0.3-0.5, and sliding torque had large coefficient of friction mu and wearing the disk out greatly.
[0053] Moreover, since [than 80 micrometers / that there are few loadings of a carbon fiber as 20 capacity %, and the pitch diameter of the pore which exists in a sliding surface is larger and] the rate of occupancy area was larger than 30%, reinforcement was as small as 55MPa(s), and thermal resistance was also as low as less than 200 degrees C at sample No.3. And 0.3-0.5, and sliding torque also had large coefficient of friction mu. In addition, although it changed with pin quality of the materials about abrasion resistance and comparatively high abrasion resistance was shown to stainless steel, to alumina ceramics, the sliding surface was greatly worn out.
[0054] Furthermore, since the rate of occupancy area of the pore which exists in a sliding surface

although thermal resistance satisfied 200 degrees C or more since each loadings of thermosetting resin and a fibrous filler are within the limits of 30 - 70 capacity % was larger than 30%, reinforcement was as small as 65MPa(s), and coefficient of friction mu had 0.4 and sliding torque large at sample No.2.
[0055] Since pore with a pitch diameter of 15-80 micrometers was made to have existed in homogeneity mostly at 3 - 30% of rate of occupancy area at the sliding surface while sample No.4-7 had each loadings of thermosetting resin and a fibrous filler within the limits of 30 - 70 capacity % to these, while having the flexural strength of 100 or more MPas, also in thermal resistance, it had 200 degrees C or more. And it had the outstanding abrasion resistance as a pin was not worn, while being able to hold down the abrasion loss in the sliding surface of a test piece to under 1x10-3mm3 / kg/km regardless of the quality of the material of a pin. And coefficient of friction mu was also found by having the outstanding sliding property from it being less than [small a single / more / figure] 0.1 as compared with sample No.1-3.
[0056]
[Table 2]

		本発明範囲外			本 発 明			
	サンプルNo.	1	2	3	4	5	6	7
配合比	ﾌｪﾉｰﾙﾉﾎﾞﾗｯｸ樹脂 (容量%)	50	40	80	60	50	40	30
	炭素繊維 (容量%)	50	60	20	40	50	60	70
気孔の平均径 (μm)		10	70	100	35	30	25	15
気孔の占有面積率 (μm)		2	33	35	22	15	12	5
荷重たわみ温度		200	200	160	205	210	215	215
曲げ強度 (MPa)		120	65	55	105	110	102	115
ﾃﾞｨｽｸ比摩耗量(10^{-8}mm^3/kg/km)		135	15	235	0.3	0.2	0.2	0.1
ピン比摩耗量(10^{-8}mm^3/kg/km)		5	2	0	0	0	0	0
動摩擦係数 μ		0.5	0.4	0.6	0.05	0.06	0.05	0.04

※ ピン材はアルミナセラミックスである。

[0057]
[Table 3]

		本発明範囲外			本 発 明			
	サンプルNo.	1	2	3	4	5	6	7
配合比	フェノールノボラック樹脂（容量%）	50	40	80	60	50	40	30
	炭素繊維（容量%）	50	60	20	40	50	60	70
気孔の平均径（μm）		10	70	100	35	30	25	15
気孔の占有面積率（μm）		2	33	35	22	15	12	5
荷重たわみ温度		200	200	160	205	210	215	215
曲げ強度（MPa）		120	65	55	105	110	102	115
ディスク比摩耗量(10^3mm^3/kg/km)		105	18	15	0.3	0.2	0.2	0.1
ピン比摩耗量(10^3mm^3/kg/km)		5	0	2	0	0	0	0
動摩擦係数 μ		0.3	0.4	0.3	0.05	0.06	0.05	0.06

※ ピン材はステンレスである。

[0058]
[Effect of the Invention] According to the slide member of this invention, the fibrous filler which consists of a carbon fiber or organic fiber As mentioned above, 30 - 70 capacity %, While making into a sliding surface one principal plane of the resin complex which consists of thermosetting resin of 70 - 30 capacity % and making pore this sliding surface exist in homogeneity mostly While it is lightweight and load deflection temperature has 200 degrees C or more, the outstanding thermal resistance, and sufficient reinforcement from having sunk in the solid lubricant of a lubricating oil or a resin system into the above-mentioned pore In sliding under a high speed and a heavy load load, the slide member which has the outstanding small sliding property of coefficient of friction can be offered cheaply that oneself and others have little wear.

[Translation done.]